Cedars Lock and Dam
At the 27.7 mile marker
on the Lower Fox River
Little Chute
Outagamie County
Wisconsin

HAER No. WI-85

HAER
WIS
44-LITCH,
1-

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
Rocky Mountain System Support Office
National Park Service
P.O. Box 25287
Denver, Colorado 80225-0287

HISTORIC AMERICAN ENGINEERING RECORD

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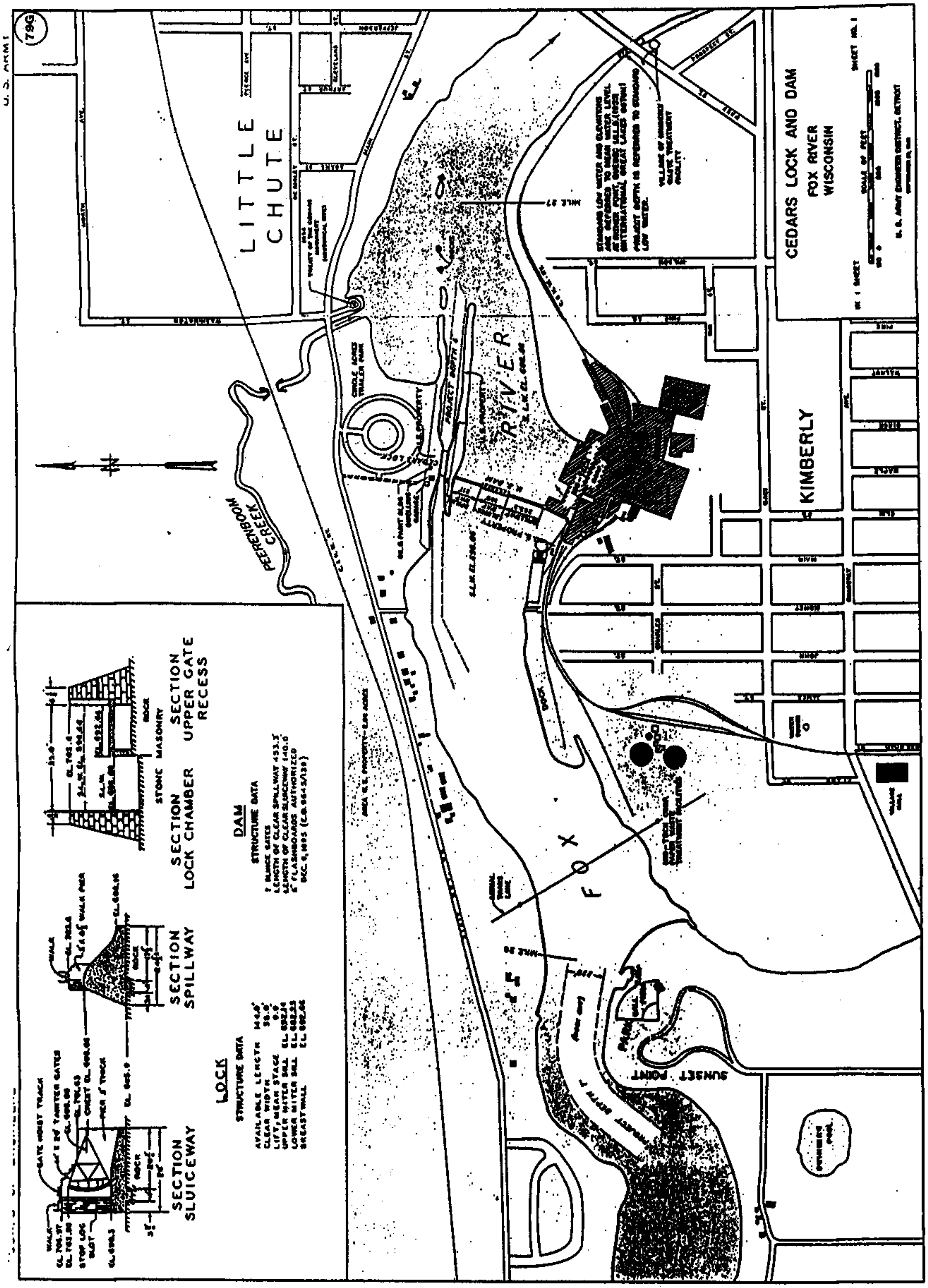
CEDARS LOCK AND DAM

HAER NO. WI-85

Location:	The Cedars Lock and Dam Complex is located between Appleton and Little Chute next to the Circle Acres Trailer Park at the 27.7 mile point on the Lower Fox River. The complex is situated south of State Trunk Highway 96 is in the SW1/4, SW1/4, NW1/4, Section 21, T21N, R18E, Civil Towns of Vandenbroek and Buchanan, Outagamie County, Wisconsin.
	UTM: North end of dam 16/393700/4903600; South end of dam 16/393640/4903420; West end of lock 16/393560/4903630; Center of lock 16/393680/4903620; East end of lock 16/393800/4903610; USGS Quadrangle: Kaukauna, Wisconsin 7.5' series
Date of Construction:	1877-1941
Engineer:	United States Army Corps of Engineers with Contractors
Architect:	United States Army Corps of Engineers with Contractors
Present Owner:	United States Army Corps of Engineers
Present Use:	The Cedars Lock is currently not in use as a navigational facility. The Cedars Dam remains operational.
Significance:	The Cedars Lock and Dam Complex allowed passage around the Cedars Rapids for water craft navigating between Little Chute and Appleton and thus served as one integral part of the Lower Fox River Waterway System.
Project Information:	This documentation was undertaken in 1995 in accordance with requirements detailed in a June 19, 1994 letter from Gregory D. Kendrick, Chief, History Branch, NPS to Dale Monteith, Acting Chief, Planning Division, USACOE, Detroit District. The Lower Fox system remains basically operational but was placed in caretaker status by the USACOE in 1982. The USACOE plans to divest itself of the Lower Fox system as soon as is feasible; therefore, NPS requested this documentation. All documentation conforms to HAER standards.
	Dr. John D. Richards, Principal Investigator; Georgia A. Lusk, Patricia B. Richards, and Robert J. Watson, Project Archivists with Great Lakes Archaeological Research Center, Inc.; Joseph Paskus, Project Photographer.


LITTLE CHUTE
KIMBERLY
RIVER
FOX
PEETENBOOM CREEK
SUNSET POINT
CEDARS LOCK AND DAM
FOX RIVER
WISCONSIN
SECTION SLUICEWAY
SECTION SPILLWAY
SECTION LOCK CHAMBER
SECTION UPPER GATE RECESS
STONE MASONRY
LOCK
STRUCTURE DATA
DAM
STRUCTURE DATA

CEDARS LOCK AND DAM FACILITY

General Description

The Cedars Lock and Dam, located between the towns of Appleton and Little Chute, Wisconsin, is near the site where the Cedars Treaty was signed between the Menominee Indians and the United States on September 3, 1836.[1] The Cedars Lock and Dam facility enabled water craft to bypass the Cedars Rapids as the boats traveled between Appleton and Little Chute on the Lower Fox River. The present facility, built between 1887 and 1941, consists of the Cedars lock, dam, canal, a lockkeeper's house, lock shelter, garage and storage shed.

History

In 1848, the Board of Public Works of the newly formed State of Wisconsin appointed engineer Condy R. Alton to survey and assess the condition of the existing dams on the Fox River and suggest navigational improvements to other areas of the river.[2] In his assessment of the Cedar's Rapids, Alton recommended the construction of a dam, lock, and canal.[3]

Coincident with construction of other facilities along the Fox-Wisconsin Waterway, construction of the original dam and timber lock structure at the Cedars Rapids was begun in 1850.[4] The original construction included a 700 foot dam with a 6 foot head, a single 140 foot long lock with a 10 foot drop, and approximately 660 feet of canal. As construction progressed in 1851, the commissioners of the Board of Public Works decided that all new locks should be 160 feet long and 35 feet wide in order to accommodate larger vessels.[5] The construction company of White, Resly, and Arndt, who were charged with constructing the Cedars facility, began building the lock to these required dimensions.[6] The first locks were designed to be constructed of timber, but were actually built as a composite timber and stone lock.[7] By late 1851, construction of the Cedars dam and canal was completed and the completion of the lock was projected for the summer of 1852.[8] By 1853, the locks were still not completed, and a legislative committee began an investigation into the slow pace of construction.[9] The committee found the delays due in part to fiscal limitations placed on the project and the conflict which had developed between Morgan L. Martin and Governor Leonard Farwell in 1852-1853. An ardent supporter of the Fox-Wisconsin system since its inception, Martin played a key role in securing federal funding for the project when he was Wisconsin's territorial delegate to Congress from 1845 to 1847.[10] In 1851, the State Legislature contracted with Martin to construct the facilities at Kaukauna and Little Chute.[11] At the heart of the dispute between Martin and Farwell were issues relating to the payment due to Martin for construction at these facilities.[12] However, the Cedars facility was operational by 1856, when the Aquila became the first steamer to successfully navigate the Fox-Wisconsin Waterway.[13]

Maintaining, operating, and improving the Cedars facility was a constant problem. An 1866 survey of the Cedar's facility found that the 740 foot long dam had settled from 1 to 18 inches over the entire length of the dam. Additionally, the condition of the lock had deteriorated, requiring gate repairs and replacement of decayed timbers.[14]

Following the purchase of the Fox-Wisconsin lock and dam system by the federal government in 1872, Major D.C. Houston was assigned the responsibility of overseeing operation of the waterway.[15] One of Houston's first actions was initiation of a survey conducted by government surveyors in order to assess the condition of the Fox-Wisconsin Waterway. During the course of the survey, it was noted that the Cedars Lock and Dam were in fairly good condition, while other facilities on the Fox-Wisconsin system required extensive work and repairs.[16]

Following the 1872 survey, the United States Army Corps of Engineers embarked on a program designed to keep the Fox-Wisconsin system open to navigation.[17] This program consisted of regular maintenance and construction at lock and dam facilities as well as dredging of navigation canals.[18] Throughout the early history of the Cedars facilities, several repairs were made to the lock.

Construction of the original composite lock at the Cedar's facility began in 1850.[19] This lock was built of stone and timber, was 160 feet in length, and 35 feet wide, and had a 10 foot drop.[20] Ten years after the completion of the Cedars lock, an 1872 survey found the lock gates in need of repair. The survey also suggested replacement of some lock chamber timbers.[21] Between 1872 and 1875, rock was dredged from the lock chamber, the lock was replanked where needed, and gate repairs were completed.[22] In 1878, the two upper lock gates were replaced.[23] Additional repairs were conducted on the lock walls and a new capstan platform was constructed in 1879.[24] By 1880, lock wall planking had been replaced and a new timber gate was installed. In addition, two new hollow quoins were installed on the lower gate and new coping was installed on the south wall and along 75 feet of the north wall.[25]

In 1880, due to the deteriorating condition of several of the lock and dam facilities on the Fox River, the U.S. government initiated an extensive rebuilding project on the Lower Fox that continued through 1890.[26] In 1887, the original Cedars lock was removed and construction of the present lock was completed in 1888.[27] The new lock chamber and walls were constructed of limestone blocks. New lower gates were built for the lock at the time of its completion, while the 1879 upper gates were rehabilitated. All four gates are constructed of squared wood timbers. In 1941, the 1887 gates were replaced with new twenty foot pine timber mitre gates.[28]

By 1932, a conditions report noted that the original dam was decaying rapidly.[29] It was also noted at this time that in its present state of disrepair, the old dam could no longer adequately discharge flood waters.[30] Consequently, construction of a new concrete dam with an overall length of 654 feet was begun in 1933 and completed in 1934.[31] No structural modifications are known to have been made to the dam since its completion.[32]

The 1852 canal has been periodically dredged throughout its existence in order to maintain a navigable depth. The present Cedars canal is aligned east to west and is approximately 1,350 feet long. Canal width varies between 40 feet at the lock to 150 feet at the eastern end. A cut stone retaining wall lines most of the canal bank.

The original lockkeeper's residence at the Cedars Lock and Dam facility was constructed in 1893. Between 1901 and 1909, this structure underwent numerous structural repairs including the installation of new hardwood flooring in the dining room and kitchen.[33] By 1927 a decision was made to replace the old lockkeeper's residence with a new dwelling at a total cost of $ 8, 811.25.[34] This new structure is a Dutch Colonial Revival style house commonly used for lockkeeper's residences at Fox River lock and dam facilities. Additional standing structures at the Cedar's facility include a lock shelter (circa 1917), a modern garage, and a modern metal shed.

CEDARS DAM

The existing Cedars dam has changed little since it was rebuilt in concrete between 1933 and 1934. Oriented SSW/NNE, the dam measures 654 feet 4 inches in length and is comprised of three sections: two spillways located on the southern and northern ends of the dam; and a central sluiceway.[35] The dam is anchored to bedrock at the river's bottom, and maintains a standard low water pool elevation of 700.36 feet above mean sea level, resulting in an average pool depth of 10 to 11 feet.[36]

North Spillway

The North spillway is 211 feet long. The length of the north spillway is defined by the portion of the dam between the channel face on the northernmost abutment and the southernmost pier section of the sluiceway.[37]

The northern end of the north spillway is connected to the existing concrete abutment which was constructed prior to 1933. The abutment is 43 feet long and 17 feet 6 inches in height. The wall of the abutment extends perpendicular to the spillway and parallel to the river. The upstream abutment is slightly angled north into the river's bank. A 16 foot long support wall is attached perpendicular to the head wall. The wall is tapered on both faces from a 5 foot basal width to a 3 foot width at its top. The head wall of the abutment is beveled on its canalward side.[38]

A new support wall parallel to the main axis of the old abutment was built in 1933. The new wall is positioned 43 feet downstream from the upstream head of the old abutment and is 20 feet in length. The new support wall is slightly tapered on its exterior face from a 3 foot 11 1/2 inch top width to a 6 foot 6 inch basal thickness. The new portion of the north abutment is secured to the bedrock bottom of the river by ten 1 1/2 inch by 4 foot metal dowels tied into the rock and the existing abutment by ten 1 inch by 3 foot machine bolts with double cinch anchors set 1 foot 3 inches into the existing abutment.[39]

The north spillway is comprised of twelve poured concrete construction sections. Each construction section is anchored to the bedrock of the river bottom by sixteen four 1 inch by 1 foot 6 inch steel anchor bolts grouted into the rock with 3/4 inch tie rods, and by five 1 1/2 inch by 4 foot split iron dowels grouted into the rock at the upstream end of the section.[40] In addition to the iron fasteners, a 4 foot wide concrete key, poured into a trench cut at a minimum depth of 2 feet into the bedrock, runs the entire length of the spillway, securing it to the river's bottom.[41]

The width of each individual construction section varies according to its position in the overall layout of the spillway; however depth of each section is uniformly 25 feet. The three sections nearest the abutments are 16 feet 6 inches wide, while the three sections nearest the sluices are 18 feet 2 inches wide. The remaining six construction sections of the north spillway each extend 17 feet 10 inches in width. The end section of the north spillway, located adjacent to the north abutment, is tied to the abutment by twenty 1 inch by 2 foot 6 inch machine bolts with double cinch anchors set 1 foot 3 inch into the abutment and spaced 3 feet apart center to center. The construction section located adjacent to the first pier section of the dam's sluiceway is tied to the first sluiceway pier section by 1 inch by 3 foot stub bolts screwed into 1 inch by 3 foot sleeve nuts in the sluice pier.[42]

Aside from their differing widths, each construction section of the north spillway conforms to specifications of a generalized construction section plan. When measured parallel to the river channel, each construction section has a basal length of 25 feet. The upstream face of the north spillway, located 7 feet from the crest line at its base, is beveled at a 12V:5H pitch. From this point, the upstream face of the spillway curves toward the crest line at a 2 foot 2 inch radius. The downstream face of the north spillway, measuring 18 feet 4 inches horizontally from the crest line to the downstream edge, is constructed as a compound curve consisting of three tangential circles with radii of 9 feet, 10 feet, and 4 inches.[43]

When measured from the rock bottom of the Fox River, each construction section of the east spillway is approximately 12 feet at the crest line. The crest line is the highest point of the spillway, maintaining an elevation of 700.36 feet above sea level. By comparison, the downstream "toe" of the spillway measures 1 foot 6 inches from the average elevation of the river bottom, maintaining an average elevation of 689.86 feet above sea level.[44]

The spillway construction sections are secured together by a concrete mortise and tenon joint running the full height of each spillway section. The tenon is secured in a 5 1/2 inches deep mortise in the adjoining construction section. A 3/8 by 12 inch steel plate securing the mortise to the tenon runs the full height of the section. The seams between each spillway section are filled by 1/8 inch thick construction joints, with 1/8 inch thick expansion joints at every third joint. At each expansion joint, a 1/32 by 15 inch soft copper sheet runs the entire height of the concrete mortise and tenon joint.[45]

Beginning at the northern abutment, the fourth, seventh, and tenth construction sections of the north spillway support concrete piers which serve as the base for a metal walkway running the length of the spillway. The longitudinal centerline of each walk pier is located at a distance of approximately 9 feet from the eastern upstream edge of the spillway construction section on which it is located. The are a total of three walkway support piers located along the northern spillway.[46]

The walk piers of the northern spillway are bullet shaped, with the parabolic end pointing upstream. Each pier measures 8 feet 4 inches from the tip of the parabolic end to the downstream edge. Measured from the downstream side, the pier sections maintain their maximum width of 3 feet for a length of 5 feet, at which point the sides begin to curve gently toward the tip of the parabola. Each side of the pier arches toward the upstream tip, maintaining a curve with a 5 foot circular radius. The upstream nose of each of the walkway piers is armored with a 6 foot 3 inch section of 4 by 4 by 3/8 inch angle iron secured onto the pier with 3/4 by 18 inch countersunk steel bolts.[47]

The walk piers are tied into the individual spillway construction sections by two concrete keys recessed into the top of the construction section. The upper key measures 3 feet 3 3/8 inches in length, and is recessed 6 inches into the surface of the front portion of the spillway construction section. The downstream key is located 2 feet 6 inches from the upper key and is recessed 18 inches into the downstream surface of the spillway section. In addition to the concrete keys, the spillway piers are secured to the spillway construction section upon which it sits with 13 sections of 3/8 inch by 5 foot rebar and a longer section of 3/8 inch by 6 foot 3 inch vertical rebar at the nose of the pier. The rebar sections are spaced 15 inches center to center from one another, 3 inches inside the outer dimensions of the pier.[48] Various lengths of horizontal rebar provide additional stability to the spillway piers.

In profile, the walkway piers are somewhat rectangular, with concave bottoms conforming to the curved upper surfaces of the spillway construction sections. The piers were designed to reach an elevation of 705.5 feet above sea level at pier top. Measured from the point of contact with the spillway construction section, the difference in elevation of the upstream end of the walk piers is 6 feet 3 inches, while the difference in elevation of the downstream end is 7 feet 3 inches. On the downstream end of the pier there are two 12 inch risers carry the elevation from 705.5 to 703.5 feet above sea level.[49]

A walkway spans the entire length of the north spillway from the dam abutment to the first pier section of the sluiceway. The walkway over the north spillway consists of sections of channel iron bolted onto the walkway pier sections with split anchor bolts fitted with specially beveled washers. The interior space between the channel beams is spanned by lengths of I beams which have been bolted to the channel iron.[50] The horizontal I beam sections serve as support ribs along the entire length of the walkway.

On the exterior of the channel beams, sections of angle iron have been spaced along the length of the spillway to form the uprights for a handrail.[51] The walkway uprights are spaced so that the bolts used to secure the horizontal I beam sections to the interior of the channel beam can also serve as the lower of two bolts used to secure the uprights to the exterior of the beam.[52] On each side of the north spillway walkway, two lengths of 1/2 inch galvanized 7 strand Siemens-Martin wire rope has been threaded through holes drilled in the walkway uprights.[53]

The decking of the spillway walkway is made up of sections of 3 inches by 12 inches planking laid three across to cover the span between the channel beams.[54] The planking has been nailed onto 3 foot 2 inch sections of 4 by 4 inch beams which are bolted to the tops of the horizontal I beam sections spanning the interior space between the channel beams.[55]

A power and lighting electric transmission line was added to the Cedars dam in 1933 in order to facilitate the installation of electric lighting and power fixtures. Lamp posts were erected on the seven spillway piers, the hoist house, alternate sluice piers, and the noses of the two centermost sluice piers. The lamp posts consist of 10 foot high, 1 inch conduit terminating in a 3/4 inch vapor proof galvanized light fixture with a globe, screw guard, sealing plate, and gasket. These lamp posts are mounted to the spillway piers with a 1 1/2 by 4 1/2 inch cast iron floor flange mounted 9 inches from the edge of the walkway.[56]

South Spillway

The southern spillway, located closest to the Kimberly-Clarke Power House and Water Purification Plant, is similar to the northern spillway in many respects. The major difference between the two spillway sections of the Cedars dam is that the southern spillway is noticeably longer than the northern spillway, with an overall length of 263 feet 4 inches.[57] The length of the southern spillway is defined by the portion of the dam between the Electrical Power House on the southernmost abutment and the northernmost pier section of the sluiceway.[58] In addition, a 10 foot wide ice sluice is located between the Power House brick wall and the first segment of the southern dam abutment of the spillway.

The southern spillway is attached to the north wall of the Kimberly-Clarke Power House, and extends 263 feet 4 inches north to join the south end of the sluiceway. The concrete abutment at the south end of the spillway, located at the northern end of the ice sluice, was poured as one section during the construction of the spillway. The curved wall of the ice sluice, is approximately 27 feet long, and varies in width from 4 feet to 7 feet. The upstream end of the ice sluice wall is rounded to form a semi-circle with a 4 foot 3 inch radius. Constructed entirely of form-poured concrete, this wall forms the south abutment of the Cedars dam. The south abutment is secured to the bedrock bottom of the river by eighteen 1 1/2 inch by 4 foot split dowels spaced 1 foot from the sides of the wall and sunk into the rock.[59] The concrete wall is anchored to the masonry wall of the Kimberly-Clarke Power House with eleven, 1 inch by 2 foot 6 inch machine bolts with cinch anchors set 1 foot 3 inch into the masonry wall.

The south spillway is comprised of fifteen poured concrete construction sections.[60] Construction of the south spillway is very similar to that of the north spillway sections. Each construction section is anchored to the bedrock of the river bottom by sixteen 1 inch by 1 foot 6 inch steel anchor bolts grouted into the rock with 3/4 inch tie rods, and by five 1 1/2 inch by 4 foot split iron dowels grouted into the rock at the upstream end of the section.[61] In addition to the iron fasteners, a 4 foot wide concrete key, poured into a trench cut at a minimum depth of 2 feet into the bedrock, runs the entire length of the spillway, securing it to the river's bottom.[62]

The width of individual construction sections varies according to each section's position in the overall layout of the spillway; construction section length is a uniform 25 feet. The construction section containing the ice sluice abuts the right abutment near the Power House. This section is 15 feet 4 inches wide. The two adjacent sections are each 16 feet 6 inches wide. The next nine sections are each 17 feet 10 inches in width. The remaining three sections are each 18 feet 2 inches wide. The northernmost section of the south spillway is tied to the first sluiceway pier section by 1 inch by 3 foot stub bolts screwed into 1 inch by 3 foot sleeve nuts in the sluice pier.[63]

Aside from their differing widths, each construction section of the north spillway conforms to specifications of a generalized construction section plan. When measured parallel to the river channel, each construction section has a basal length of 25 feet. The upstream face of the south spillway, located 7 feet from the crest line at its base, is beveled at a 12V:5H pitch. From this point, the upstream face of the spillway curves toward the crest line at a 2 foot 2 inch radius. The downstream face of the south spillway, measuring 18 feet 4 inches horizontally from the crest line to the down stream edge, is constructed as a compound curve consisting of three tangential circles with radii of 9 feet, 10 feet, and 4 inches.[64]

When measured from the rock bottom of the Fox River, each construction section of the east spillway is approximately 12 feet at the crest line. The crest line is the highest point of the spillway, maintaining an elevation of 700.36 feet above sea level. By comparison, the downstream "toe" of the spillway measures 1 foot 6 inches above the average elevation of the river bottom, maintaining an average elevation of 689.86 feet above sea level.[65]

The spillway construction sections are secured together by a concrete mortise and tenon joint extending the full height of each spillway section. The tenon, slightly beveled from a 23 inch maximum to 21 inches at its leading edge, is secured in a 5 1/2 inch deep mortise in the adjoining construction section. A 1/8 by 12 inch steel plate securing the mortise to the tenon runs the full height of the section. The seams between each spillway section are filled by 1/8 inch thick construction joints, with 1/8 inch thick expansion joints at every third seam. At each expansion joint, a 1/32 by 15 inch soft copper sheet extends the entire height of the concrete mortise and tenon joint.[66]

The fourth, seventh, tenth, and thirteenth construction sections of the south spillway support concrete piers which serve as the base for a metal walkway running the length of the spillway. The longitudinal centerline of each walkway pier is located at a distance of approximately 9 feet from the eastern upstream edge of the spillway construction section on which it is located.[67] The are a total of four walkway support piers located along the southern spillway.

The walkway piers of the southern spillway are bullet shaped, with the parabolic end pointing upstream. Each pier measures 8 feet 4 inches from the tip of the parabolic end to the downstream edge. Measured from the downstream side, the pier sections maintain a maximum width of 3 feet for a length of 5 feet, at which point the sides begin to curve gently toward the tip of the parabola. Each side of the pier arches toward the upstream tip, describing a curve with a 5 foot circular radius. The upstream nose of each of the walkway piers is armored with a 6 foot 3 inch section of 4 by 4 by 3/8 inch angle iron secured onto the pier with 3/4 by 18 inch steel bolts.[68]

The walkway piers are tied into the individual spillway construction sections by two concrete keys recessed into the top of the construction section. The upper key is 3 feet 3 3/8 inches in length, and is recessed 6 inches into the surface of the front portion of the spillway construction section.

The downstream key is located 2 feet 6 inches from the upper key and is recessed 18 inches into the downstream surface of the spillway section. In addition to the concrete keys, each spillway pier is secured to the spillway construction section upon which it sits with 13 sections of 3/8 inch by 5 foot rebar and a longer 6 foot 3 inch section of 3/8 inch rebar at the nose of the pier. The rebar sections are spaced 15 inches center to center from one another, 3 inches inside the outer dimensions of the pier.[69] Various lengths of horizontal rebar provide additional reinforcement for the spillway piers.

In profile, the walkway piers are somewhat rectangular, with concave bottoms conforming to the curved surfaces of the spillway construction sections. The piers were designed to reach an elevation of 705.5 feet above sea level at pier top. The top of each walk pier is thus approximately 5.14 feet higher than the crest elevation. On the downstream end of the pier are two 12 inch risers which carry the elevation from 705.5 to 703.5 feet above sea level.[70]

A walkway spans the entire length of the south spillway from the dam abutment to the first pier section of the sluiceway. The walkway over the south spillway consists of sections of channel iron bolted onto the walkway pier sections with split anchor bolts fitted with specially beveled washers. The interior space between the channel beams is spanned by I beams which have been bolted to the channel iron.[71] The horizontal I beam sections serve as support ribs along the entire length of the walkway.

On the exterior of the channel beams, sections of angle iron have been spaced along the length of the spillway to form the uprights for a handrail. The walkway uprights are spaced so that the bolts used to secure the horizontal I beam sections to the interior of the channel beam can also serve as the lower of two bolts used to secure the uprights to the exterior of the beam. On each side of the south spillway walkway, two lengths of 1/2 inch galvanized 7 strand Siemens-Martin wire rope has been threaded through holes drilled in the walkway uprights.[72]

The decking of the spillway walkway is made up of sections of 3 by 12 inch planking laid three across to cover the span between the channel beams. The planking has been nailed onto 3 foot 2 inch sections of 4 by 4 inch beams which are bolted to the tops of the horizontal I beam sections spanning the interior space between the channel beams.[73]

A power and lighting electric transmission line was added to the Cedars dam in 1933 in order to facilitate the installation of electric lighting and power fixtures. Lamp posts were constructed for the seven spillway piers, the hoist house, alternate sluice piers, and the noses of two centermost sluice piers. The lamp posts consist of 10 foot high, 1 inch conduit terminating in a 3/4 inch vapor proof galvanized light fixture with a globe, screw guard, sealing plate, and gasket. These lamp posts are mounted to the spillway piers with a 1 1/2 inch by 4 1/2 cast iron floor flange mounted 9 inches from the walkway.[74]

<u>Sluiceway</u>

The sluiceway section of the Cedars dam is centrally located in the overall layout of the dam, between the two spillways. The overall length of the sluiceway is 180 feet. The sluiceway is comprised of eight poured concrete construction sections. Each sluiceway construction section is anchored to the bedrock of the river bottom by four rows of steel anchor bolts spanning the width of the section. The first row of bolts is located 5 feet 9 inches from the upstream edge of the section, the second row is 5 feet from this row and the other two rows are spaced at 6 foot 9 inch intervals. The first and second rows consist of six 4 foot 6 inch lengths of 1 1/2 inch diameter split bolts anchored 18 inches into the bedrock. The bolts are spaced 4 feet apart, center to center. The third and fourth rows of bolts each contain six, 1 inch diameter bolts spaced at 4 foot intervals and anchored 18 inches into the bedrock. The bolts in the third row are each 3 feet 6 inches in length, while those of the fourth row are 3 feet long.[75] The spillway construction sections are also held to the bottom by a 4 foot wide concrete key, poured into a trench cut at a minimum depth of 2 feet into the bedrock which extends the entire length of the spillway. Additional reinforcement is provided by 4 foot 6 inch long upright sections of rebar which are spaced at 18 inch intervals in two rows 2 feet apart the entire length of the key.[76]

The construction sections of the sluiceway conform to the specifications of a generalized construction section plan. With the exception of the extreme right end section and the extreme left end section of the sluiceway, which are 15 feet in width, each of the construction sections is 25 feet wide. Measured parallel to the river channel, each section is 28 feet long.[77]

Somewhat ramp-shaped in profile, the sluiceway construction sections reach a maximum height of 4.4 feet from the average elevation of the river bottom, or 692.0 feet above mean sea level. From an upstream height of 2 feet 6 inches above the average elevation of the river bottom, the sluiceway sections slope up to achieve the 4.4 foot height at a horizontal distance of 3 feet 9 inches feet from the upstream end. The 4.4 foot height is maintained for a horizontal distance of 8 feet, at which point the section begins to slope gently downstream to a height of 6 inches above the average elevation of the river bottom at the extreme downstream edge. Thus, the downstream top of the sluiceway sections are elevated 689.0 feet above mean sea level.[78]

The sluiceway construction sections are secured together by lengths of 1 inch diameter rebar which extend the width of each section and are spaced at 15 inch intervals. Additional lengths of 3/8 inch diameter rebar have been placed longitudinally across the section, spaced at 2 foot intervals. The seams between sluiceway construction sections are filled by construction joints.[79]

The sluiceway construction sections of the Cedars dam serve as foundations for a series of eight upright piers which not only support a sluiceway walkway, but also contain the gate pins on which the sluiceway taintor gates are hung. Six of the sluiceway piers are located along the centerlines of construction sections, while the two end piers are located at the extreme ends of the southern and northern sections.[80] Seven sluices are created by the placement of the pier sections.

The sluiceway piers are 28 feet in length, and measure 5 feet in width. The upstream ends of the piers are parabolic in shape, curved along a radius of 6 feet 3 inches. The upstream nose of each of the piers is armored with a 18 foot 2 inch long section of 4 by 4 by 3/8 inch angle iron secured onto the pier with 3/4 by 18 inch steel bolts. Sluiceway pier heads measure 4 feet 4 inches from the parabolic tip of the upstream end to the downstream edge. Immediately posterior of the pier heads is a "stop log" slot that extends the entire height of the pier section. The stop log slots, which are 6 inches deep and 13 inches wide, are located on pier faces interior of sluiceway openings. The downstream corners of the stop log slots have been armored with 16 foot 8 inch long sections of 4 by 4 by 3/8 inch angle iron secured onto the pier face with 3/4 by 18 inch steel bolts.[81]

The sluiceway piers are tied to the sluiceway construction sections by two rectangular concrete keys, sections of rebar, and anchor bolts. Both concrete keys extend 6 inches from the top of the sluiceway sections into the bottom of the pier sections. The first key, located on top of the horizontal section of the sluiceway construction section, is 6 feet in length and 2 feet in width. The key is secured to the sluiceway construction section with eight 3/4 inch diameter by 5 foot long bars spaced at 22 inch intervals along the length of the key. The second key, located on top of the slanted downstream section of the sluiceway construction section, is 10 feet long and 2 feet wide. The key is secured to the sluiceway construction section with two rows of 3/4 inch diameter by 5 foot long bars spaced at 22 inch intervals along the length of the key. In addition to the concrete keys, each sluiceway pier is tied to the construction sections with 19 sections of 3/8 inch diameter rebar. The rebar sections are spaced 18 inches center to center from one another, 4 inches inside the outer dimensions of the pier. The lengths of the rebar sections vary according to their position in the pier section, with 14 foot 6 inch, 16 foot, 17 foot, and 17 foot 6 inch sections utilized in the upstream end, and 12 foot, 12 foot 6 inches, 13 foot, and 13 foot 6 inch sections used in the downstream end.[82]

In profile, the sluiceway piers are rectangular, with the upstream portion stepped up by four 16 inch risers above the rest of the pier section. The upstream surfaces of the sluiceway piers reach an elevation of 708.67 feet above sea level, while the downstream surfaces are constructed at an elevation of 703.37 feet above sea level. The upstream end of each sluiceway pier is raised approximately 18 feet 2 inches above the top of the underlying sluiceway construction sections; downstream ends are raised approximately 13 feet 4 inches above the upper surface of the base sections.[83]

The taintor gates are hung on a 6 foot 8 incb long, 6 inch diameter cold rolled steel gate pin by a cast steel gate hinge. Each gate is connected to the gate hinges by end girders and bracing composed of 8 by 8 by 3/4 inch angle iron. The upper and lower arms of the end girders are 16 foot sections of angle iron bolted to the gate hinges with 7/8 inch rivets. The upper and lower arms of the taintor gate end girders form the sides of an isosceles triangle with a 40° angle located adjacent to the gate hinge. The arms of the end girders are braced with three sections of triangulated 3 by 3 x 3/8 inch angle iron. Two of these angle iron sections are also connected to a 3/8 inch thick steel web plate which spans the space between the upper and lower arms directly behind the taintor gate face. The space between gate end girders is spanned by sections of channel iron running the width of the gate and connecting the upper and lower arms of opposite gate end girders. Additional bracing between end girders is located 5 feet 4 inches behind the gate face at the top and bottom of the gate. A 3/8 inch thick steel web plate is located directly behind the gate face at the centerline of the gate. This web plate is, in turn, tied to the horizontal gate bracing by two 4 foot 9 inch sections of 3 by 3 by 3/8 inch angle iron.[84]

The fronts of the sluiceway gates are faced with 3/8 inch thick steel plates secured to the gate bracing and web plates by 8 by 18 1/4 inch horizontal I beams. Seams between the plates are secured by 6 inch wide strips of 3/8 inch steel plate which run the entire height of the taintor gate. A twenty foot long 8 by 8 inch oak beam is bolted to the channel iron running along the foot of the gate, providing a sill for the gate.[85]

The sluiceway gates of the Cedars dam are operated by a "crab", a mechanism containing a pair of electric winches that moves from gate to gate along a track on top of the sluiceway.[86] The crab is constructed of two 21 foot lengths of channel iron connected parallel to each other by four sections of 2 foot 2 1/2 inch I beam iron. The crab winches are powered by a five horse power open type wound rotor motor mounted at the middle of the crab frame. A winch hand wheel is also located near the middle of the crab frame. The crab mechanism rides along a 3 foot 8 inch gauge track mounted over the downstream side of the sluiceway.[87]

In order to raise or lower a gate, the crab is positioned over the gate, and the winch chains are connected to the hoist chain connections on the gate.[88] Once positioned, the crab is connected to a power source, and the winches are engaged until the gate has been raised to the desired height. Once this height is reached, the crab is disconnected from the power source and moved to the next gate to be opened.[89] The electric winches are capable of lifting the gate at a rate of 2 feet per minute. In contrast, 61.5 revolutions of the hand wheel are required to lift the gate 1 foot.[90]

When not in use, the crab mechanism is housed in a wooden structure built over the span between the two sluiceway piers adjacent to the northern spillway. The gate hoist house is built on top of two 22 foot 4 inch horizontal timbers spanning the space between the sluiceway piers. Along the upstream side of the gate hoist house, a 4 by 4 inch sill plate has been bolted directly to the top of the sluiceway walkway planking. The sill plate on the downstream side of the crab house is a 4 by 8 inch beam which has been bolted 1 foot 3 inches above the top of the sluiceway pier section. At each end of the sill plates, 4 by 4 inch wall studs are fastened directly to the sill plate. Between these beams, 2 by 4 inch studs have been spaced 2 feet apart, center to center.[91] On top of the 4 by 4 inch wall studs, two 2 by 4 inch beams have been strung to form the top plate.

A 2 foot 8 inch personnel door is located on the right side of the gate hoist house at the spillway end of the structure. A set of 5 foot 6 inch by 5 foot 9 inch double doors on the sluiceway side of the gate hoist house allow the crab to be removed from the structure, moved along its track, and positioned at the gates. The upstream and downstream sides of the crab house each contain a single window located in the center of the wall. The crab house is covered with a moderately pitched, front-gabled asphalt shingle roof.[92]

A walkway spans the entire length of the sluiceway.[93] The walkway over the sluiceway consists of sections of channel iron bolted onto the sluiceway pier sections with split anchor bolts fitted with specially beveled washers. The interior space between the channel beams is spanned by I beams which have been bolted to the channel iron.[94] The horizontal I beam sections serve as support ribs along the entire length of the walkway.

On the exterior of the channel beams, sections of angle iron have been spaced along the length of the sluiceway to form the uprights for a handrail. The walkway uprights are spaced so that the bolts used to secure the horizontal I beam sections to the interior of the channel beam can also serve as the lower of two bolts used to secure the uprights to the exterior of the beam. On each side of the sluiceway walkway, two lengths of 1/2 inch galvanized 7 strand Siemens-Martin wire rope has been threaded through holes drilled in the walkway uprights.[95]

The decking of the sluiceway walkway is made up of sections of 3 by 12 inch planking laid three across to cover the span between the channel beams.[96] The planking has been nailed onto 3 foot 2 inch sections of 4 by 4 inch beams which are bolted to the tops of the horizontal I beam sections spanning the interior space between the channel beams.[97]

A 5 foot 4 inch wide by 8 foot long steamhouse is located on top of the fifth sluiceway pier from the end of the northern spillway. Constructed in the 1980s, the steamhouse is a pre-fabricated structure manufactured by Armco Building Systems of Cincinnati, Ohio. The modular wall panels, which are bolted directly onto the sluiceway pier, support four 16 inch roof panels.[98] An entrance door is located on the upstream side of the steamhouse, and a single, louvered vent is centered on the downstream side.[99]

The steamhouse is used to store a portable steam cleaner employed to periodically clean the dam surface and gates. The steam cleaner is also used to melt ice that builds up on the gates and hampers gate operation during the winter.[100]

CEDARS CANAL

The Cedars locks are located within an excavated canal that bypasses the Cedars dam to the north.[101] The Cedars canal was excavated in 1852, when Wisconsin Board of Public Works engineer Condy R. Alton proposed the construction of a dam and 660 feet of canal.[102]

Today, the Cedars canal is aligned east to west and is approximately 1,350 feet long, including the portion of the canal that lies within the lock. The lower canal is much wider than the upper canal.

The canal's width varies between 40 feet at the lock to approximately 150 feet at the eastern end and 125 feet at the western end. Roughly 825 feet of the canal is located below the lower wing walls of the lock, while 450 feet of canal extends above the upper wing walls.[103] The 1852 channel has been periodically dredged in order to maintain a navigable depth.

The lower canal banks have been riprapped with stone.[104] In contrast, a cut stone retaining wall lines most of each bank of the upper canal. Along the northern bank, the retaining wall has a length of 325 feet while the southern wall is slightly longer extending 350 feet.[105]

CEDARS LOCK

The Cedars lock has changed little since its construction in 1887-1888. Oriented NW/SE, the lock consists of a 144 foot by 35 foot quarried limestone lock chamber with wing walls at each end.[106]

The lower wing walls, or those located at the downstream end of the lock, are 16 feet 6 inches high. Each lower end wing wall consists of a single construction section built of rubble masonry. The north wall measures 38 feet in length and is 10 feet wide at its base, while the south wall is 40 feet long and 10 feet wide at its base. The north and south masonry walls are 4 feet 6 inches wide at their tops, and are beveled on their exterior faces at a 1V:10H slope.[107]

The upper wing walls, located at the upstream end of the lock, are 11.7 feet high. Each upper wing wall consists of a single construction section of rubble masonry. The north wall is 180 feet in length and is 5 feet wide at its base, while the south wall is 170 feet long and 10 feet feet in width at its base.[108] The north upper wing wall is 4 feet 6 inches wide at its top and tapers on the face exterior of the lock channel at a 1V:8H slope. The south wall is also 4 feet 6 inches wide at its top, but is tapered at a 1V:10H slope exterior of the lock channel.

The lock chamber of the Cedars lock measures 132 feet 6 inches between the upper and lower gate sections of the lock. Located at the west end of the lock, the upper gate section measures 40 feet 5 inches in length, and the lower gate section is 46 feet 9 inches in length.[109] Including the upper and lower gate sections, the overall length of the lock is 220 feet 6 inches.[110]

The upper gate section is that part of the lock which contains the upper valve mechanisms used to fill the lock. Spaced 39 feet 6 inches apart, the walls of the upper gate section are 22 feet high and 5 feet wide. The wall surfaces facing the lock channel are made up of thirteen tiers of 19 inch thick quarried limestone blocks laid in horizontal courses to form the face of the wall. Rubble masonry has been built up behind the cut blocks in order to reinforce the wall. At its base, the block wall is 8 feet wide and is tapered to a 4 foot 6 inch width at its top. The walls of the upper gate section are built directly on top of limestone bedrock with their interior faces perpendicular to the natural rock floor of the lock. Directly behind the upper lock gates, the interior walls of the upper gate section are recessed 2 feet to allow the gates to recess flush when opened.[111]

The original wooden gates of the Cedars lock were replaced in 1941.[112] Design sheets specific to these replacement gates are not among the plans of the Cedars lock facility on file at the Fox River Project Office. However, since the Cedars lock is identical in design and construction to Appleton Lock 1 and Kaukauna Lock 1, plans from these facilities augmented by visual inspection of the Cedars locks were used to compile a description of the Cedars lock gates.

The upper gate is constructed from squared pine timbers laid in horizontal courses and held together with vertical oak beams.[113] In addition to the oak beams, the pine timbers used in the gate construction of the lock are secured together by vertical steel I beams bolted to both faces of the gate with 3/4 inch and 1 1/4 inch bolts. The upper lock gate is 9 feet 7 inches high and 20 feet 9 inches wide.[114]

The upper lock gates are closed by horizontal spars which connect the inside of the gates to geared vertical shafts enclosed within steel tripods mounted on both sides of the lock wall. A removable bar is inserted into a socketed hub attached to a vertical shaft and serves as a handle used to turn the shaft. In order to open or close the gate, the locktender must use the handle to rotate the vertical shaft by walking around the tripod. If the gates are to be opened, the locktender walks in a counterclockwise direction, and if the gates are to be closed, the locktender walks in a clockwise direction.

Prior to 1941, the five butterfly valves which allowed the water level of the lock chamber to be raised were located within the walls of the upper gate section.[115] The original five valves were replaced in 1941 with four new butterfly valves set into the floor of the lock.[116] As these valves are opened, water flows into a culvert under the upper gate section sill and into the lock chamber. The valves are operated by metal shafts which connect the valve to geared hand wheels positioned on top of the lock walls near the gate. The upstream valves fill the lock chamber to provide the 9.8 feet of lift required to match the 700.94 feet above sea level elevation of the upper pool in a little over 5 minutes.[117]

The lower gate section is that part of the lock which contains the lower valve mechanisms used to empty the lock. Spaced 35 feet apart, the walls of the lower gate section are 22 feet high and 5 feet wide. The wall surfaces facing the lock channel consist of seventeen tiers of 17 inch thick quarried limestone blocks laid in horizontal courses to form the face of the wall. Rubble masonry has been built up behind the cut blocks in order to reinforce the wall. At its base, the block wall is 10 feet wide and tapers to 4 feet 6 inches at its top. The walls of the lower gate section are built directly on top of limestone bedrock, and their interior faces are perpendicular to the natural rock floor of the lock. Directly behind the upper lock gates, the interior faces of the upper gate walls are recessed 2 feet in order to allow the gates to recess flush when fully opened.[118]

The original wooden gates of the lower gate section were replaced in 1941.[119] The replacement gates are similar to those designed for Appleton Lock 1. The lower gates are constructed from squared pine timbers laid in horizontal courses and held together with vertical oak beams.[120] In addition to the oak beams, the timbers used in the lower gate construction are secured by vertical steel I beams bolted to both faces of the gate with 3/4 inch and 1 1/4 inch bolts. The lower gates are similar to the upper gates in their construction, except that they are considerably taller, reaching a height of 19 feet 6 inches.[121]

The lower lock gates are closed by horizontal spars which connect the inside of the gates to geared vertical shafts enclosed within steel tripods mounted on both sides of the lock wall. A removable bar is inserted into a socketed hub attached to a vertical shaft and serves as a handle with which to turn the shaft. In order to open or close the gate, the locktender must use the handle to rotate the vertical shaft by walking around the tripod. If the gates are to be opened, the locktender walks in a counterclockwise direction, and if the gates are to be closed, the locktender walks in a clockwise direction.

When the lock gates are closed and sealed, six butterfly valves located in the lower lock gates are opened and water is allowed to flow out of the lock. Arranged three to a gate, the valves are operated by levers located on the top of each gate. When opened, the lower valves can discharge the lock chamber to the lower pool elevation in 2 minutes and 54 seconds.[122]

The lock chamber wall between the upper and lower gate sections is constructed of fourteen tiers of quarried limestone blocks laid in horizontal courses to form the face of the wall. Rubble masonry has been built up behind the cut blocks in order to reinforce the wall. At its base, the block wall of the lock chamber is 10 feet in width, and is beveled to a 4 foot 6 inch width at the top of the wall. The walls of the lock chamber are built directly on top of limestone bedrock, and interior wall faces are perpendicular to the natural rock floor of the lock.[123]

In recent years, steel pipe guard rails and concrete tripod platforms have been added to the Cedars facility. In addition, both sets of gates have been repaired. However, apart from these superficial improvements and other minor periodic repairs to the gates, valves, and stone walls, the Cedars lock appears very much as it did when construction of the cut stone masonry lock was completed in 1888.

SIGNIFICANCE

The Cedars Lock and Dam Complex is a part of the Lower Fox River Waterway System constructed by private companies between 1850 and 1860 and rebuilt by the United States Army Corps of Engineers between 1872 and 1941. Conceived as part of the larger Fox River Waterway, the Lower Fox River System operated between Green Bay and Lake Winnebago. The lock and dam combination at the Cedars Lock and Dam Complex allowed passage around the Cedars Rapids between Little Chute and Appleton and served as an integral part of the Lower Fox River Waterway System.

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Proposed Reconstruction, Cedars Dam, Spillway Plan and Typical Sections, File #4-N-11.3, sheet 3.

Proposed Reconstruction, De Pere Dam, Sluiceway Plan and Typical Section, 1928, File #4-N-4.3, sheet 2.

Proposed Reconstruction, De Pere Dam, Steel Details, File #4-N-4.3, sheet 4, 1928.

Proposed Reconstruction, De Pere Dam, Steel Sluice Gate, File #4-N-4.3, sheet 5, 1928.

Statistical Information "Tracing of Blueprint furnished by the Chief of Engineers Office, Kaukauna Office record # 15-13-58, July 27 1913.

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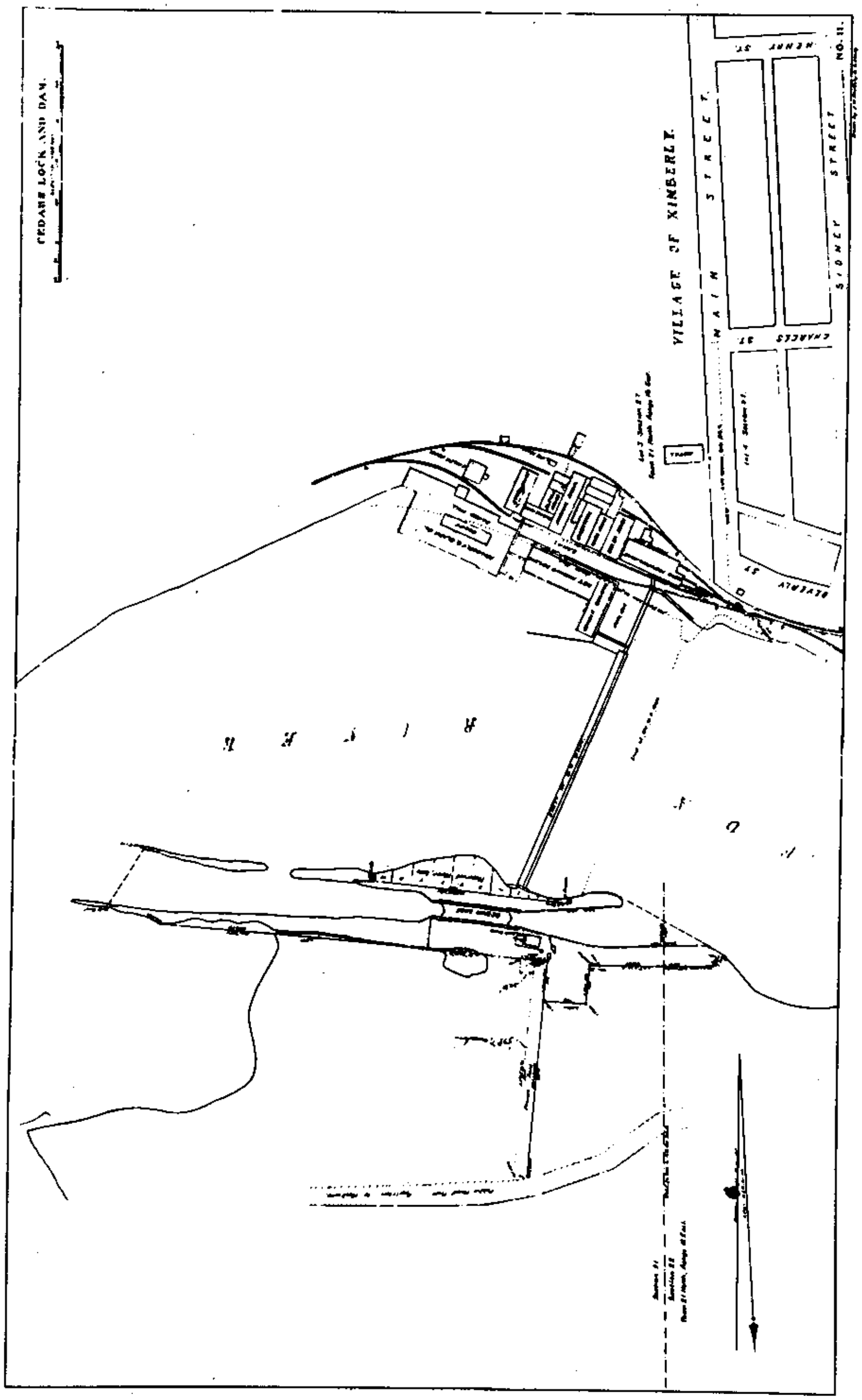
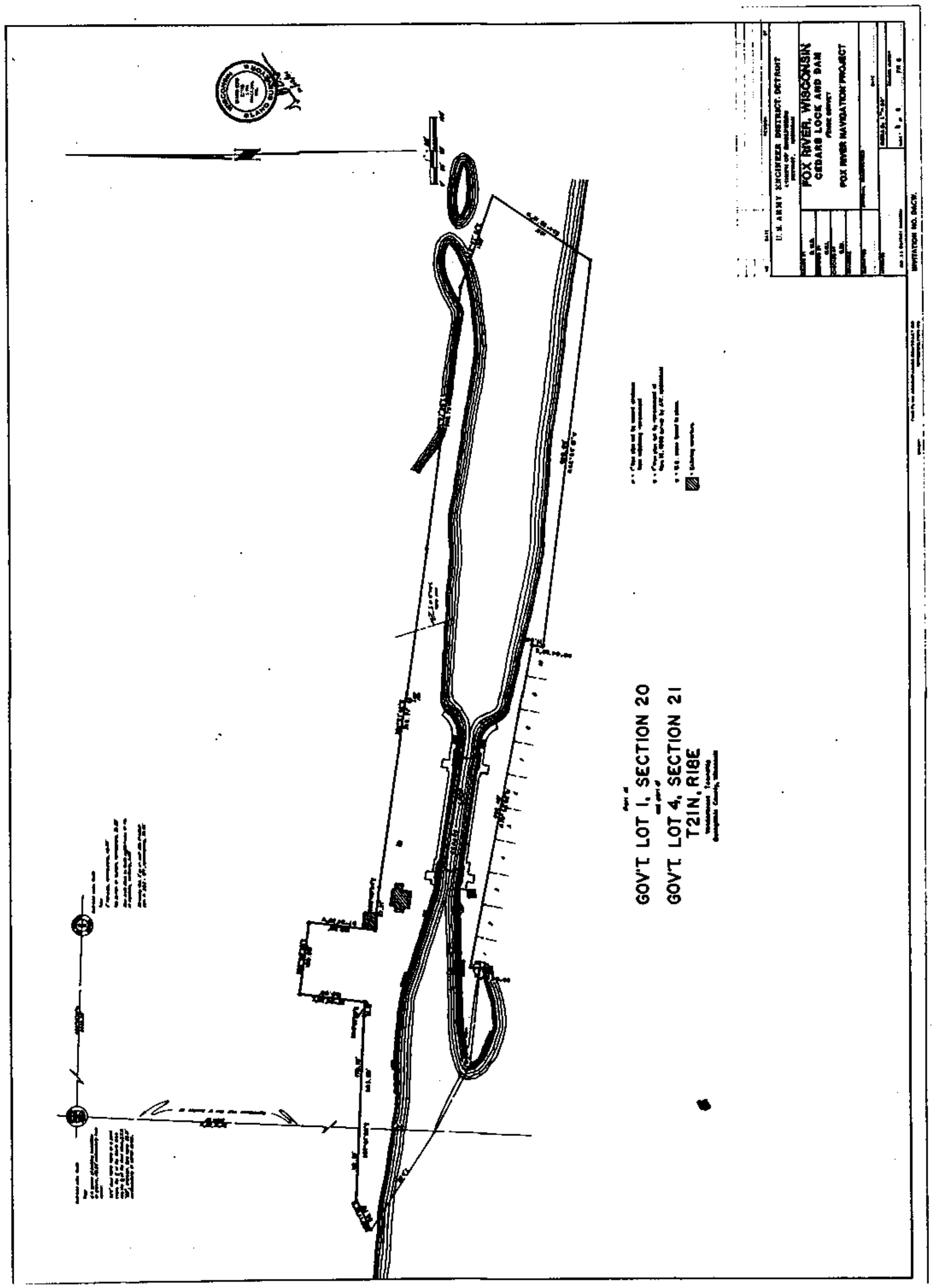
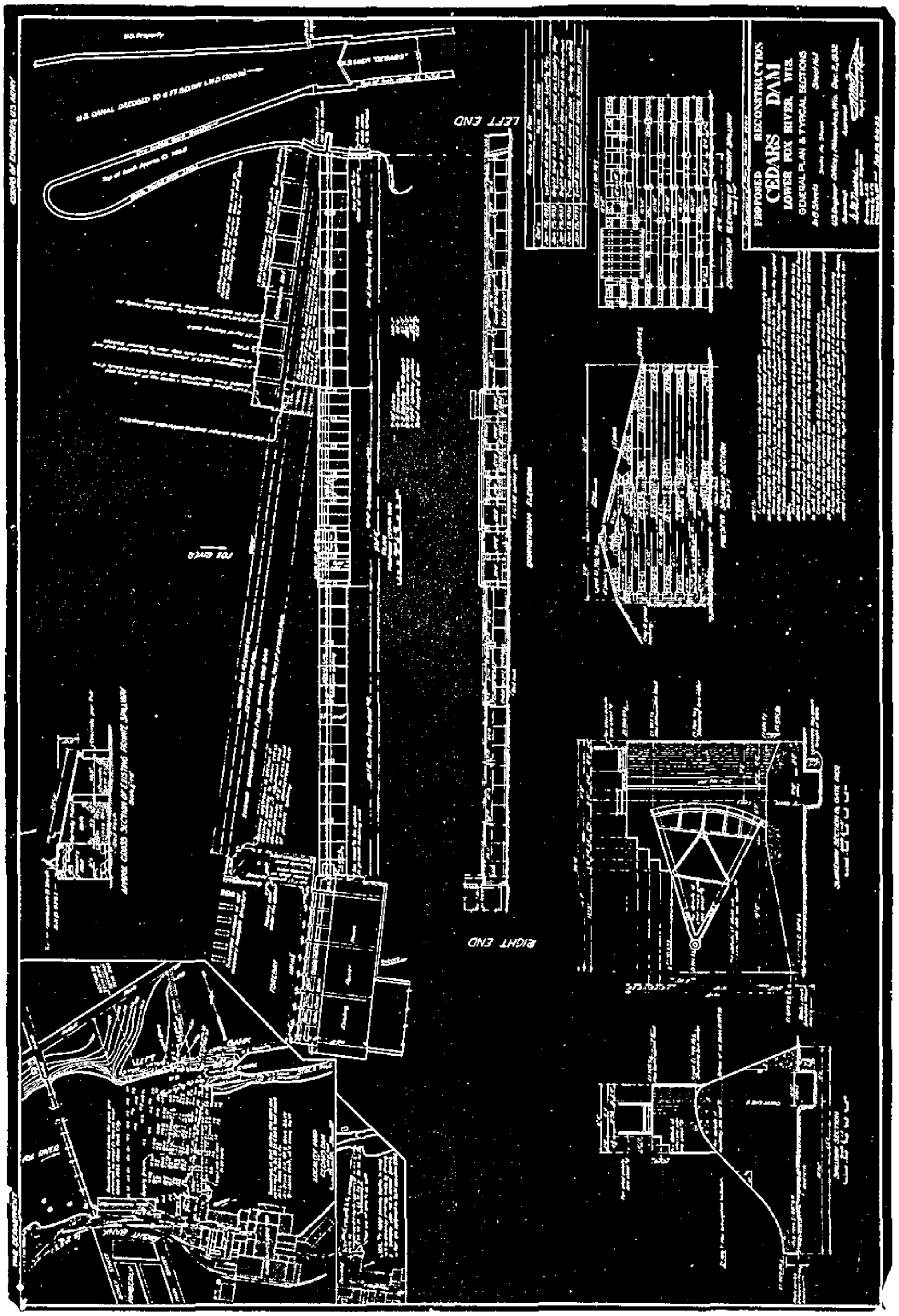


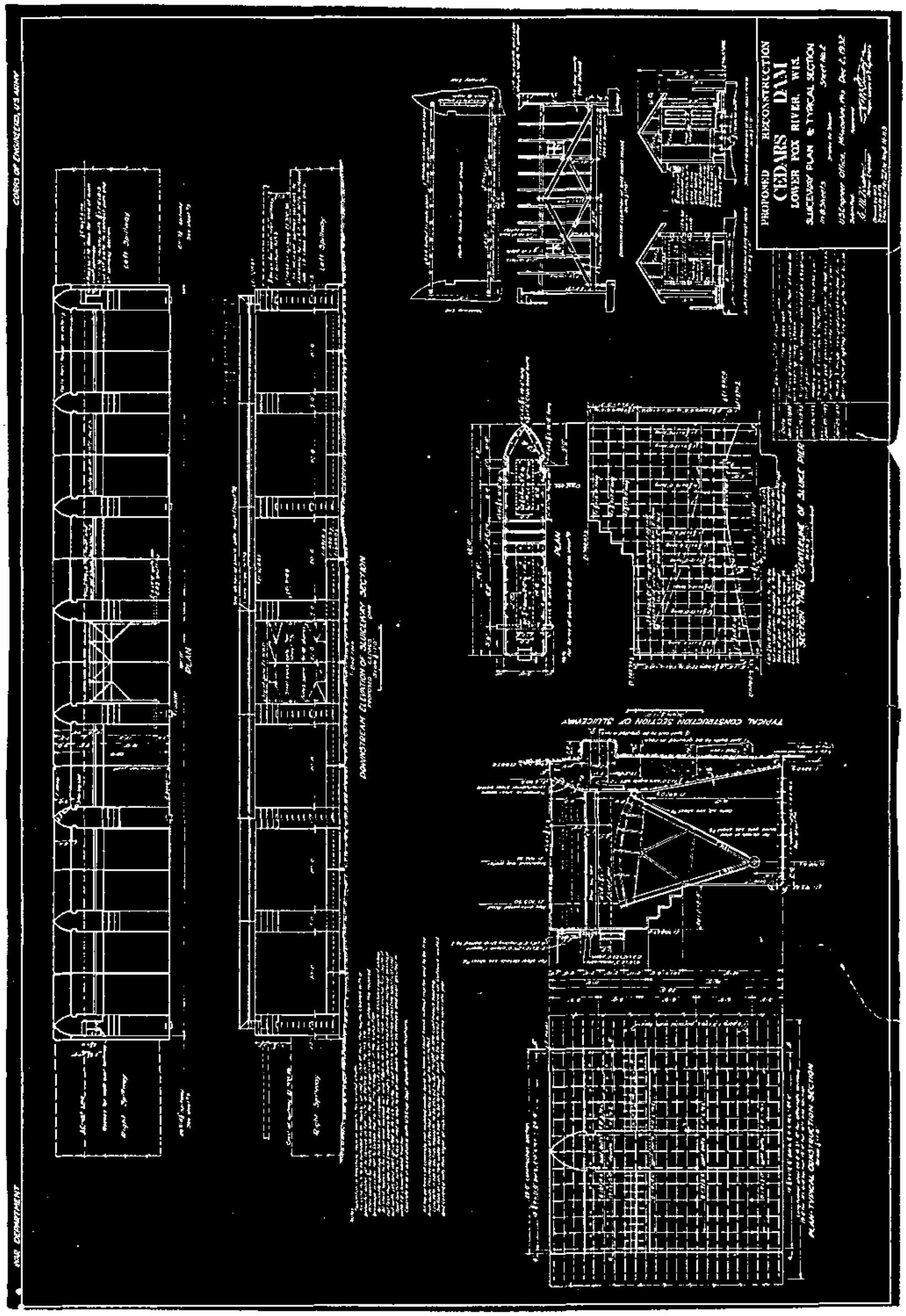
Photocopy of Beardsley and Young Map of Cedars Lock and Dam, 1900, sheet 11.



Photocopy of Cedars Lock and Dam Map, Fence Survey, File No. FR5, sheet 2.



Photocopy, Blueprint of Plan of Proposed Reconstruction, Cedars Dam, General Plan and Typical Sections, 1932, File #4-N-11.3, sheet 1.



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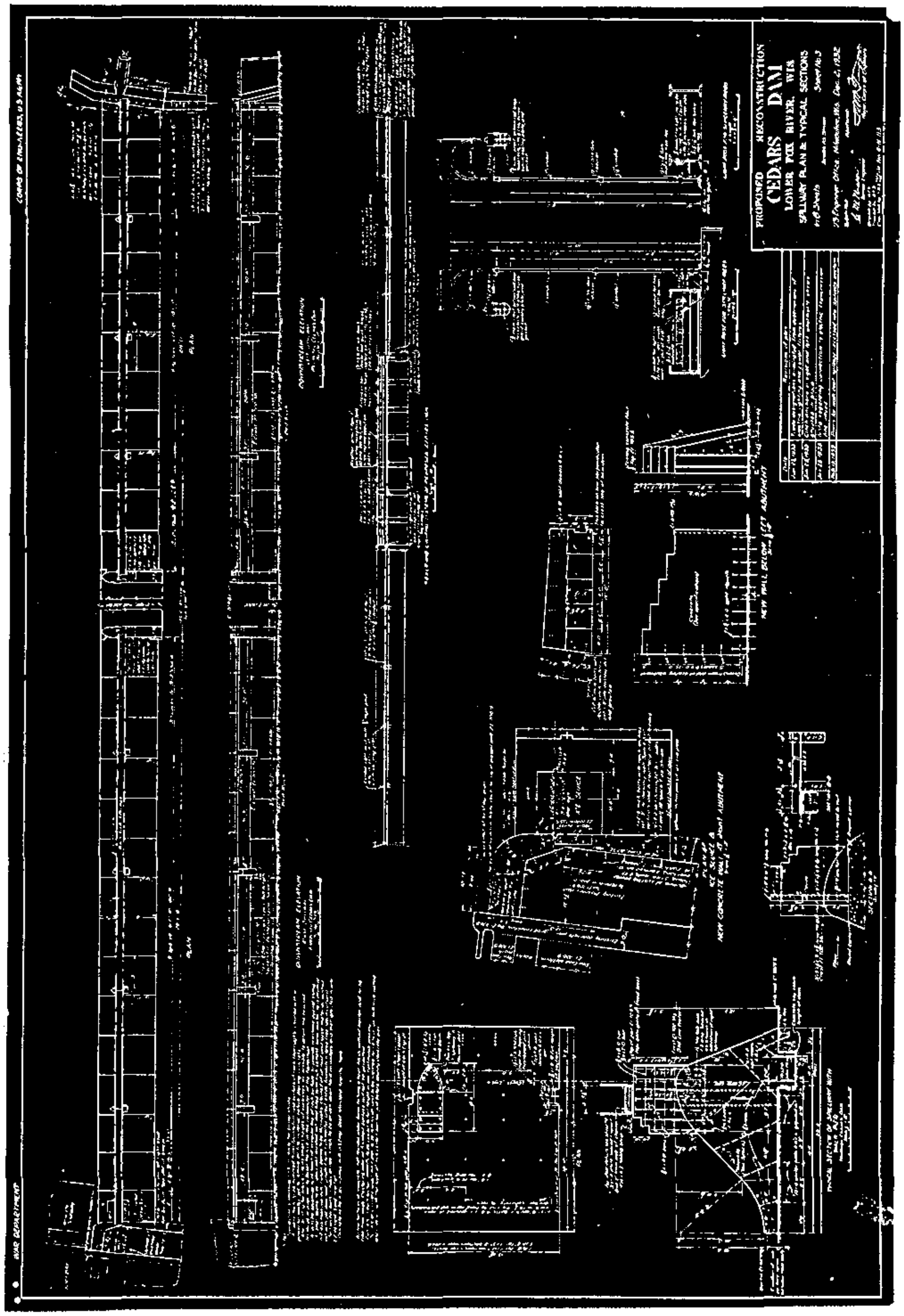
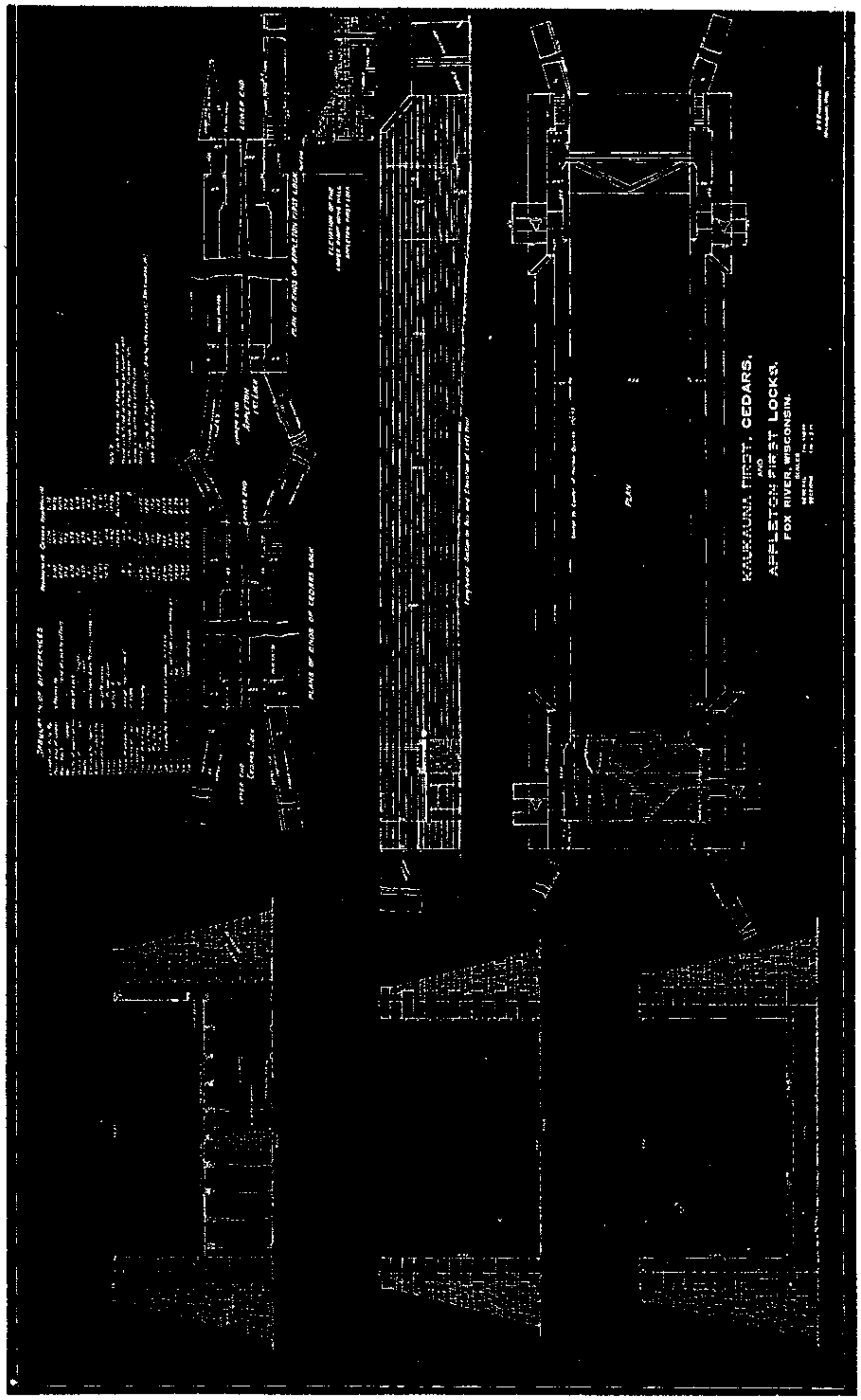


Photocopy, Blueprint of Plan of Proposed Reconstruction, Cedars Dam, Spillway Plan and Typical Sections, 1932, File #4-N-11.3, sheet 3.



Photocopy, Blueprint of Kaukauna First, Cedars and Appleton First Locks, File #4111.